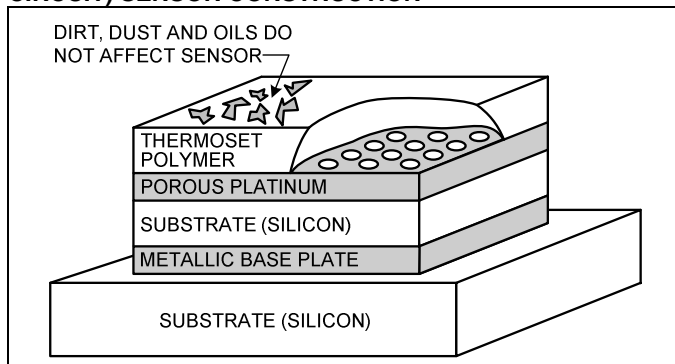


SENSOR CONSTRUCTION

Relative humidity sensors use an industrially-proven, thermoset polymer, three layer capacitance construction, platinum electrodes, and except for high temperature versions, on-chip silicon integrated voltage output signal conditioning.

In operation, water vapor in the active capacitor's dielectric layer equilibrates with the surrounding gas. The porous platinum layer shields the dielectric response from external influences while the protective polymer over layer provides mechanical protection for the platinum layer from contaminants such as dirt, dust and oils. A heavy contaminant layer of dirt will slow down the sensor's response time because it will take longer for water vapor to equilibrate in the sensor. (See the RHIC in Figure 1.)

FIGURE 1. RHIC (RELATIVE HUMIDITY INTEGRATED CIRCUIT) SENSOR CONSTRUCTION



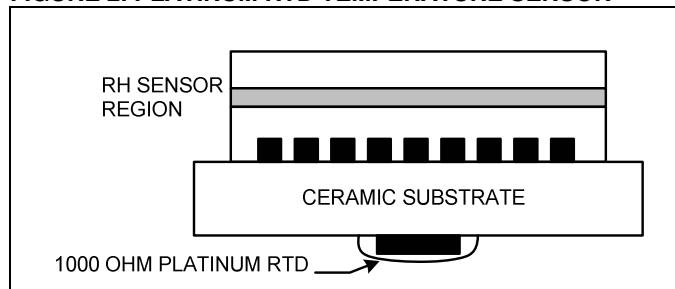
TEMPERATURE AND HUMIDITY EFFECTS

The output of all absorption-based humidity sensors (capacitive, bulk resistive, conductive film, etc.) is affected by both temperature and %RH. Because of this, temperature compensation is used in applications which call for either higher accuracy or wider operating temperature ranges.

When temperature compensating a humidity sensor, ensure the temperature measurement is as close as possible to the humidity sensor's active area, i.e. within the same moisture micro-environment. This is especially true when combining RH and temperature as a method for measuring dew point.

Industrial-grade humidity and dew point instruments incorporate a 1000 Ohm platinum RTD on the back of the ceramic sensor substrate for unmatched temperature compensation measurement integrity. No on-chip signal conditioning is provided in these high temperature sensors. (See Figure 2.)

FIGURE 2. PLATINUM RTD TEMPERATURE SENSOR



VOLTAGE OUTPUT

The RHIC sensor linear voltage output is a function of V_{SUPPLY} , %RH and temperature. The output is "ratiometric" i.e. as the supply voltage rises, the output voltage rises in the same proportion. A surface plot of the sensor behavior for temperatures between 0 °C and 85 °C [32 °F and 185 °F] is shown in Figure 3. This surface plot is well approximated by a combination of two equations:

1. A "Best Fit Line at 25 °C [77 °F]" or a similar sensor-specific equation at 25 °C. The sensor independent "typical" Best Fit Line at 25 °C (bold line in graph is:

$$V_{\text{OUT}} = V_{\text{SUPPLY}} (0.0062 (\% \text{RH}) + 0.16)$$

$$\% \text{RH} = (V_{\text{OUT}} / V_{\text{SUPPLY}} - 0.16) / 0.0062$$

A sensor-specific equation may be obtained from an RH sensor printout. The printout equation assumes $V_{\text{SUPPLY}} = 5 \text{ Vdc}$ and is included or available as an option on every sensor.

2. A sensor-independent equation which corrects the %RH reading (from the Best Fit Line equation) for temperature, T:

Or:

$$\text{True RH} = (\% \text{RH}) / (1.0546 - 0.00216 T); T = \text{°C}$$

$$\text{True RH} = (\% \text{RH}) / (1.093 - 0.0012 T); T = \text{°F}$$

The equations above match the typical surface plot (Best Fit Line at 25 °C) or the actual surface plot (sensor-specific equation at 25 °C) to within the following tolerances:

$$\pm 1\% \text{ for } T > 20 \text{ °C}$$

$$\pm 2\% \text{ for } 10 \text{ °C} < T < 20 \text{ °C}$$

$$\pm 5\% \text{ for } T < 10 \text{ °C}$$

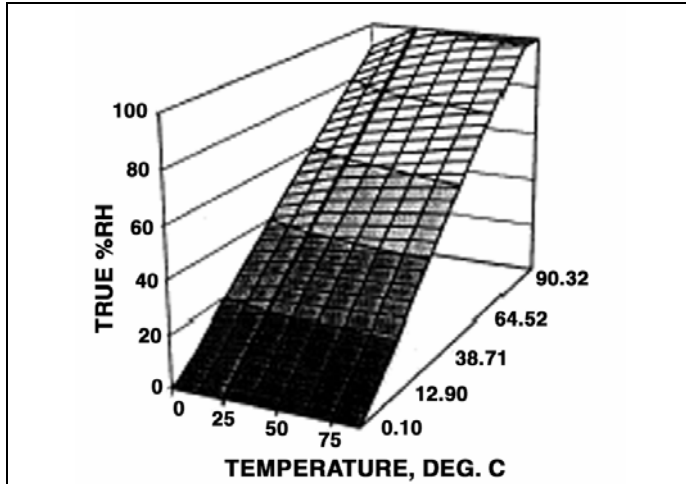
Dewpoint instruments account for the sensor-specific version of the surface plot directly via a look-up table.

Humidity Sensor Theory and Behavior

NOTICE

Convert the observed output voltage to %RH values via the first equation before applying the second equation.

FIGURE 3. TEMPERATURE VS TRUE RH



CONDENSATION AND WETTING

Condensation occurs whenever the surface temperature of the sensor's active area drops below the ambient dew point of the surrounding gas. Condensation forms on the sensor (or any surface) even if the surface temperature only momentarily drops below the ambient dew point. Small temperature fluctuations near the sensor can unknowingly cause condensation to form when operating at humidity levels above 95%.

While quick to condense, water is slow to evaporate in high humidity conditions (i.e. when the surface temperature of the sensor is only slightly above the ambient dew point). Because of this, a sensor's recovery period from either condensation or wetting is much longer than its normal time response. During recovery, the sensor outputs a constant 100% RH signal regardless of the ambient RH.

When an application calls for continuous monitoring of RH at humidity levels of 90% and above, take steps to avoid intermittent condensation. Some strategies are:

1. Maintain a good air mixing to minimize local temperature fluctuations.
2. The HIH-4602-A/C uses a sintered stainless steel filter to protect the sensor from splashes. A hydrophobic coating further suppresses condensation and wetting in rapidly saturating and de-saturating or splash-prone environments.
3. Heat the RH sensor so that the active area is hotter than the local dew point. This can be done through an external heater or by self heating of the CMOS (Complementary Metal Oxide Semiconductor) RH chip by operating it at a higher voltage.

NOTICE

Heating an RH sensor above ambient temperature changes its calibration and makes it sensitive to thermal disturbances such as air flow. When contemplating such an approach, Honeywell recommends selecting an HIH-4602 type sensor and obtaining application support.

Humidity Sensor Theory and Behavior

All RH sensors quickly recover from condensation or wetting with no shift in calibration. However, after 24 hours or longer, exposures to either high >95% RH or continuous condensation, an upward shift of 2% to 3% RH may occur. This shift is repeatable and can be reversed by placing the sensor in a low 1% RH environment for a 10 hour period.

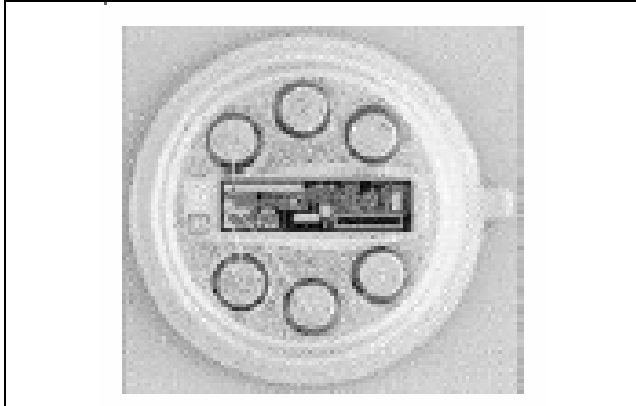
A 1% RH environment may be created in an instrumentation oven using a dry nitrogen flow of a nominal 30 CFH (Cryogenic Frostpoint Hygrometer). The time may be reduced if the temperature is raised, i.e. at a nominal 85 °C [185 °F] the nominal drying time is 1.25 hours.

INTEGRATED SIGNAL CONDITIONING

Silicon integrated humidity sensors incorporate signal conditioning circuitry on-chip with the sensing capacitor. These “RHIC” humidity sensors are laser trimmed so that at $V_{SUPPLY} = 5\text{ V}$, the output voltage typically spans 0.8 V to 3.9 V for the 0% RH to 100% RH range at 25 °C. (Sensor specific calibration data printouts and BFLs at 25 °C are either included or available as an option on every sensor.)

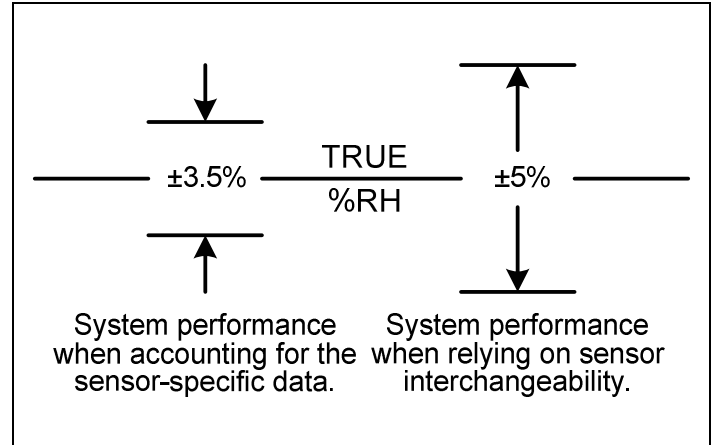
The HIH-4602-C incorporates an RHIC humidity sensor, a 1000 Ohm platinum RTD and anti-static protection in a single TO-5 can. (See Figure 5.)

FIGURE 5: HIH-4602-C



RHIC-based sensors are factory-calibrated, micro-power devices with either individual calibration and/or good unit-to-unit interchangeability. These features help OEM (Original Equipment Manufacturers) avoid in-house humidity calibration costs and extend battery life in portable instruments. Improved accuracy can be obtained by tuning system electronics to account for an individual sensor’s BFL at 25 °C. (See Figure 6.)

FIGURE 6: SYSTEM PERFORMANCE



Humidity Sensor Theory and Behavior

WARNING

PERSONAL INJURY

DO NOT USE these products as safety or emergency stop devices or in any other application where failure of the product could result in personal injury.

Failure to comply with these instructions could result in death or serious injury.

WARRANTY/REMEDY

Honeywell warrants goods of its manufacture as being free of defective materials and faulty workmanship. Honeywell's standard product warranty applies unless agreed to otherwise by Honeywell in writing; please refer to your order acknowledgement or consult your local sales office for specific warranty details. If warranted goods are returned to Honeywell during the period of coverage, Honeywell will repair or replace, at its option, without charge those items it finds defective. **The foregoing is buyer's sole remedy and is in lieu of all other warranties, expressed or implied, including those of merchantability and fitness for a particular purpose. In no event shall Honeywell be liable for consequential, special, or indirect damages.**

While we provide application assistance personally, through our literature and the Honeywell web site, it is up to the customer to determine the suitability of the product in the application.

Specifications may change without notice. The information we supply is believed to be accurate and reliable as of this printing. However, we assume no responsibility for its use.

WARNING

MISUSE OF DOCUMENTATION

- The information presented in this product sheet is for reference only. Do not use this document as a product installation guide.
- Complete installation, operation, and maintenance information is provided in the instructions supplied with each product.

Failure to comply with these instructions could result in death or serious injury.

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